RELATION BETWEEN ENZYMATIC ACTIVITIES AND COUNTS OF SOIL MICROORGANISMS

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Abstract

Enzymatic activities and counts of microorganisms were monitored on preluvosoil under different cultivation conditions (agricultural and fruit-growing preluvosoil) during the year 2008, in spring. The total number of microorganisms (N.T.G.) and enzymatic activities were evaluated using the statistical method of signification (Student test) and correlation coefficients. Soil microorganisms can be used to assess soil quality or degradation. Microbiological properties can serve as soil quality indicators because after plants soil microbes are the second most important biological agent of the agricultural ecosystem. Enzyme activity is an important indicator of soil microbiological properties. Many discussions center on the effect of farming practices, such as chemicals and fertilizers on soil microorganisms and environmental quality.

Key words: soil, microorganisms, enzymatic activities.

INTRODUCTION

Soil microbiology traditionally deals with the study of microorganisms and their processes in soil. The interaction among organisms and their environments involves soil ecology (Paul 2007). Soil microorganisms significantly contribute to the maintenance of the matter and energy turnover in terrestrial environment.

Each soil has a characteristic pattern of enzymes because all biochemical actions are dependent on or related to their presence. Soil enzyme assays are process level indicators and are presented as a means of determining the potential of a soil to degrade or to transform substrates. Soil enzyme activities are influenced by management practices because they are also related to microbial biomass which is sensitive to different treatments.

In the literature there are many references about the relationship of enzyme activities and various soil properties. Even more research exists on how the physicochemical properties of soil can influence the activity of soil enzymes. In general, enzyme activity is a good indices of soil quality because enzymes play an important role in nutrient cycles (Samuel Alina Dora, 2003). Enzyme activities are closely related to important soil quality parameters and can begin to change much sooner than other properties. Also, enzyme activities can be an integrative soil biological index of past soil management, and involve procedures that are relatively simple compared to other important soil quality properties. Several enzymes are

known to be present in the soil which catalyze organic matter turnover. These enzymes are produced by various organisms and act intra- or extra-cellular. Soil enzymes are mainly of bacterial and fungal origin. Only a small fraction is derived from plants and/or animals. The enzyme most often found in soil are dehydrogenase, catalase etc. Numerous studies have been conducted to determine changes in a soil′s enzyme activities caused by pesticides and other agricultural chemicals.

MATERIAL AND METHODS

The soil samples were collected from experimental plots field at village Cauaceu, localized at 10 kilometers from Oradea, on March 15-19.2007. The soil was collected from upper 40 cm of the agricultural preluvosoil, fruit-growing preluvosoil and control preluvosoil. In the laboratory plant material and soil macrofauna were removed and the soil samples were sieved (<2mm) and mixed. The number of total bacteria was determined using the dilution method. These soil samples (10 g), were suspended in 90 ml distilled water. Dilutions (of 10^{-6}) were prepared from the soil samples using distilled water. The soil samples taken from suitable dilution were planted in or on the solid feeding medium as required. Plate-count agar was used to estimate the total number of microorganisms. Incubation temperature was 28^{o}C. Time of cultivation was 3 days. The cells of microorganisms were counted with colony counter. In graphics the total number of microorganisms was expressed as logarithms per 1 g dry soil.

To 15g soil, were added 0,15g $CaCO_3$. The mixture was distributed in 2 test tubes. In first test tube 0,5 ml of a 3% solution of 2,3,5-triphenyl-tetrazolium chloride (TTC) and 1,5 ml distilled water were added. In the second test tube (control sample) were added only 2 ml distilled water. After incubation at 37^{0}C for 24h the formazan formed was extracted with 10 ml acetone and estimated spectrophotometrically at 485 nm. The concentration of formazan was calculated from a standard curve. Dehydrogenase activity is expressed as mg formazan formed/10 g soil·24h.

RESULTS AND DISCUSSION

Table 1

Determination of total number of microorganisms (cells/1 g soil)

Vegetation period	Microbiological indicator	Total number of microorganisms (cells/1 g soil)					
		Control (uncultivated) preluvosoil		Agricultural preluvosoil		Fruit-growing preluvosoil	
		0-20	20-40	0-20	20-40	0-20	20-40
Spring	Total microflora	$29,5x10^6$	$25,5x10^6$	$24,7x10^6$	$26,8x10^6$	$19x10^6$	$15,1x10^6$

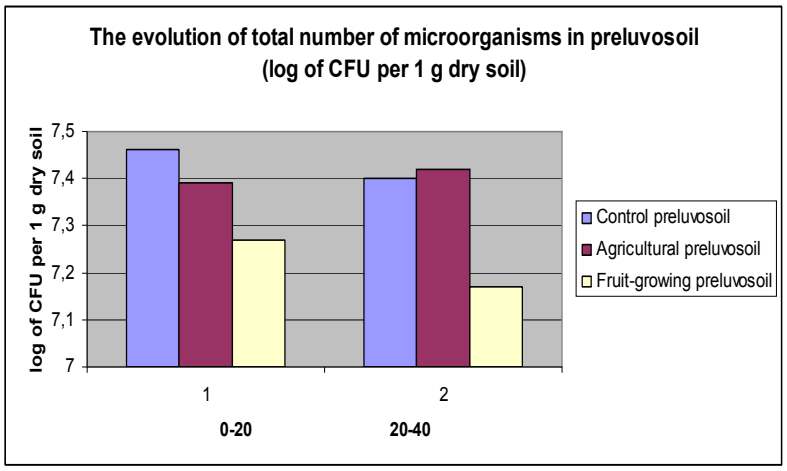

Fig. 1 The evolution of the microbiota of preluvosoil

In the soil profile (0-40 cm), the statistics interpretation of the evolution of the microbiota indicate that between the total number of microorganisms from control preluvosoil and that that of the agricultural and fruit-growing preluvosoil doesn't exist a significant difference (0,50>p>0,10). The number of total microorganisms from agricultural preluvosoil is significant higher comparative with the number of microorganisms from the fruit-growing preluvosoil. As it can bee seen, in both profile, in fruit-growing preluvosoil the total number of microorganisms is diminuaeted. The most recently studies have shown that the treatments with pesticides and fertilizers can affect the development of microorganisms. Also the presence of aluminums salts, founds in the fruit-growing preluvosoil and the acid value of pH has inhibitory effects on microbiological activity.

Table 2

Soil dehydrogenase activity (mg formazan /10 g soil·24h)

Year	Vegetation period	Depth (cm)	Control preluvosoil	Agricultural preluvosoil	Fruit-growing preluvosoil
2008	Spring	0-20	1,98	5,04	1,64
		20-40	1,7	4,13	1,02

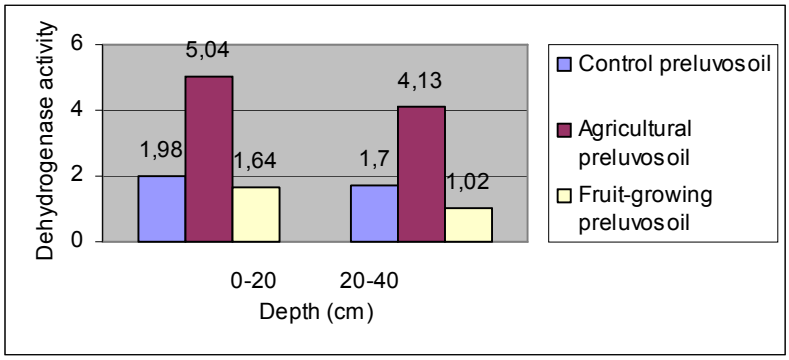

Fig.2 Soil dehydrogenase activity (mg formazan formed/10 g soil·24h)

Dehydrogenase activity is a measure of the intensity of microbial metabolism in soil and thus of microbial activity in soil. As O_2 is excluded from the soil, the total anaerobic activity increases and is reflected in an increase in dehydrogenase activity. Samuel Alina Dora (2003) has revealed that enzymatic activities of the soil decrease with depth and also the enzymatic activities of soil depend by soil cultures and practices. In his researches has show that enzymatic activities is higher in the soil cultivated with maize and wheat. As it can be seen, dehydrogenase activity of preluvosoil is higher in the superficial profile of the soil (0-20) and lower in the inferior profile (20-40).

No significant difference was observed between dehydrogenase activity of control preluvosoil and agricultural preluvosoil (0,10>p>0,05) and also between dehidrogenase activity of control preluvosoil and than that of fruit-growing preluvosoil. (0,10>p>0,05)

Significant difference was observed between dehidrogenase activity of agricultural preluvosoil and that of fruit-growing preluvosoil. (0,05>p>0,01). In the agricultural preluvosoil, dehydrogenase activities are higher than that of the fruit-growing preluvosoil.

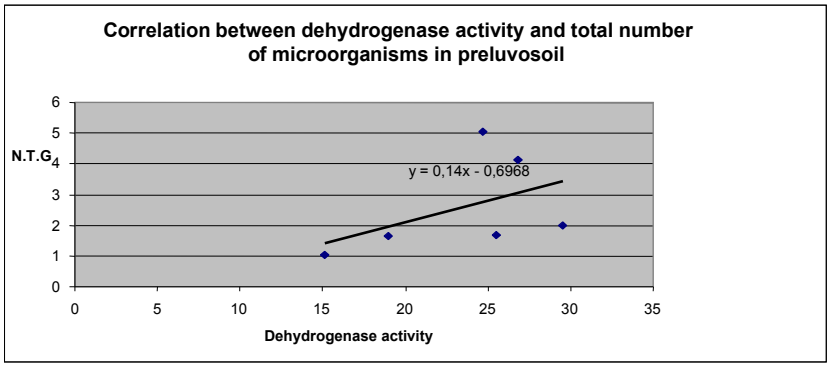

Fig. 3 Correlation between dehydrogenase activity and total number of microorganisms in preluvosoil

Enzyme activity is an important indicator of soil microbiological properties. As it can be seen in fig. 3 increasing of total number of microorganisms is correlated with the increasing of dehydrogenises activity in preluvosoil. (r=0,46).

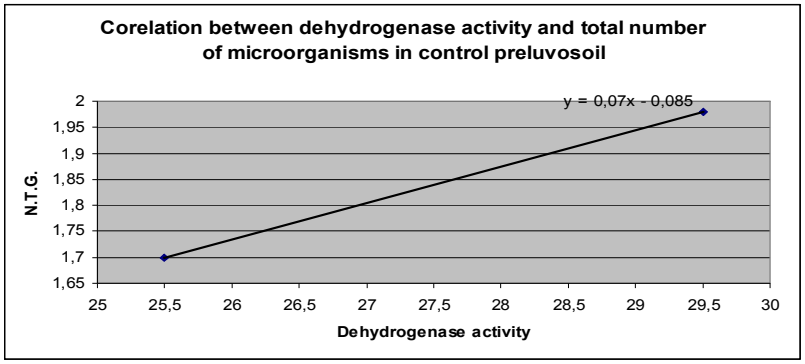

Fig. 4 Correlation between dehydrogenase activity and total number of microorganisms in uncultivated preluvosoil

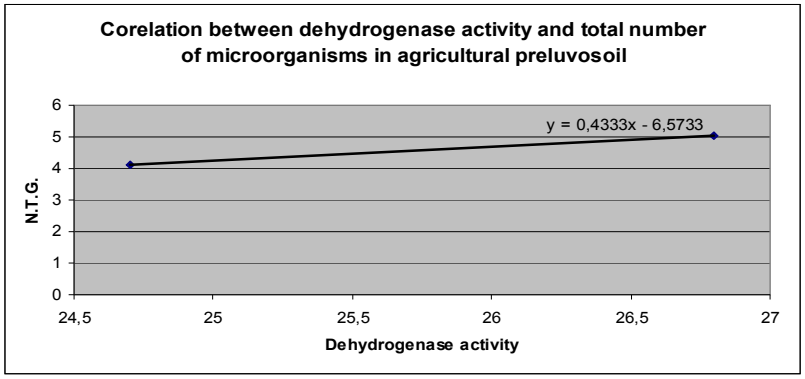

Fig. 5 Correlation betwen dehydrogenase activity and total number of microorganisms in agricultural preluvosoil

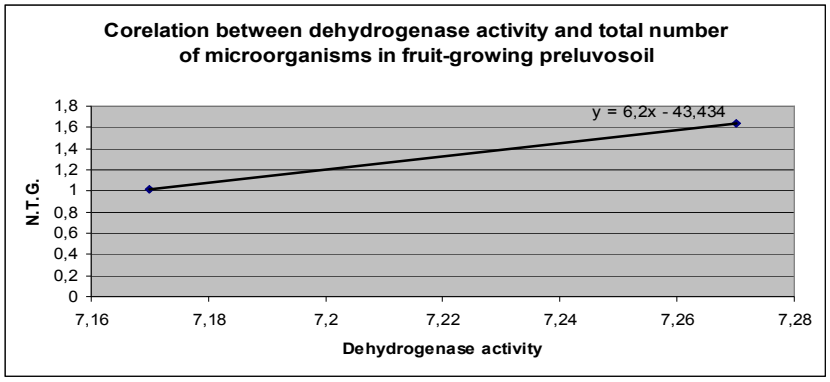

Fig. 6 Correlation between dehydrogenase activity and total number of microorganisms in fruit-growing preluvosoil

The results presented in fig. 4,5,6 showed the strong correlation (r=1) between enzymatic activities of preluvosoil under different management practices and cultivation condition (uncultivated preluvosoil, agricultural and fruit-growing preluvosoil) and the total number of microorganisms found in this soil.

CONCLUSIONS

The total number of microorganisms from agricultural preluvosoil is significant higher comparative with the number of microorganisms from the fruit-growing preluvosoil.

Enzymatic activity is an important indicator of soil microbiological properties. Dehydrogenises are enzymes produced by various microorganisms and act intra- cellular.

From research it is evident that soil enzyme activities are influenced by the system of agriculture, inputs of fertilizers and pesticides and decrease with depth. The effect of cultivation induced significant changes in the quality, chemical composition and molecular size of organic matter which in turn influenced the activities of enzymes involved in the C, N and P cycles.

Enzyme activity is also influenced by plants because they have been shown to stimulate the activity of enzymes in the rhizosphere and can be higher in planted than in unplanted soils.

The results presented in this study showed the strong correlation (r=1) between enzymatic activities of preluvosoil under different management practices and cultivation condition (uncultivated preluvosoil, agricultural and fruit-growing preluvosoil) and the total number of microorganisms found in this soil.

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